

Attachment:

Supporting Information Pertaining to Slope Gradients, Factor of Safety (FOS), and Ground Water Remedies at Several Western and International Mine Sites Mentioned in CMI's FS Report

Evaluation of Mine Site Slope Gradients

TYRONE MINE (NEW MEXICO)

Table H-1 of the Final Draft Feasibility Study (FS) indicates that overall side slopes for closure of waste rock piles at Tyrone can range from 3H:1V to 2.5:1V if highway or surface water is potentially intersected. The existing Tyrone Mine Closure Permit (DP-1341) requires that Tyrone regrade all waste rock pile and leach ore stockpile slopes to interbench slopes no steeper than 3H:1V and in the event that such regrading of an individual slope would result in the intersection of a designated surface water of the state or a highway, Tyrone may regrade such slope steeper than 3:1, as necessary to avoid the intersection, but in no event steeper than 2.5:1. However, to date, in situations where Tyrone could have exercised the option of grading waste rock pile slopes to 2.5H:1V; Tyrone instead chose to grade and remove waste rock to achieve shallower slope angles. The slopes of the 1C Waste Rock Pile were graded to 4H:1V, which required the removal and relocation of well over 33.5 MM tons of material. The slopes of other waste rock piles undergoing closure activities have been graded to angles ranging from 3H:1V to 3.5H:1V.

CHINO MINE (NEW MEXICO)

None of the waste rock pile slopes at the Chino Mine have been regarded for closure. As indicated in Table H-1 of the FS, under the current permit (DP-1340), waste rock pile slope angles at the Chino mine can range from 2.0H:1V to 3.0V:1V, depending on slope length. Additionally, the text of the FS indicates that the slopes on the west side of the West Stockpile can be graded to 2H:1V due to its adjacency to a road and creek. However, the Chino Permit is presently being renewed, and the new draft permit will require that waste rock pile slopes be graded to 3H:1V, with the exception of the west side of the West Stockpile which will be required to be graded to 2.5H:1V.

GOLDEN SUNLIGHT MINE (MONTANA)

Table H-1 in the FS indicates that the reclaimed slope angles for the waste rock piles at the Golden Sunlight Mine range from 1.19H:1V to 1.28H:1V. However, Mr. Jim Kuipers, Rio Colorado Reclamation Committee TAG Technical Advisor, in a memo prepared for the Environmental Protection Agency (EPA) and New Mexico Environment Department (NMED), indicates that the data presented in Table H-1 of the FS is for unreclaimed waste rock piles and reclaimed slopes of 2:1 or less are required.

THOMPSON CREEK MINE (IDAHO)

Table H-1 in the FS indicates that the reclaimed slope angles for the waste rock piles at the Thompson Creek Mine range from 1.27H:1V to 1.54H:1V. However, as is the case with the Golden Sunlight Mine, the above mentioned memo prepared by Mr. Jim Kuipers, indicates that the data presented in Table H-1 of the FS is for unreclaimed waste rock piles and reclaimed slopes of 2:1 or less are required at the Thompson Creek Mine.

SAN MANUEL MINE (ARIZONA)

Table H-1 in the FS indicates that waste rock piles at the San Manuel Mine were reclaimed at the angle of repose. An environmental case study prepared by BHP Billiton in 2006 indicates that the outer slopes of the waste rock piles at the San Manuel Mine were regraded to 3H:1V, not angle of repose as indicated in Table H-1 of the FS.

KIDSTON GOLD MINE (AUSTRALIA)

Table H-1 of the FS indicates that side slopes of the Kidston Gold Mine Waste Rock Piles range from 1.19H:1V to 1.33H:1V, and that the maximum height of the slopes is 250m. However, a paper presented in the Proceedings of the Eleventh Tailings and Mine Waste Conference in 2004 indicates that the waste rock dumps at the Kidston Mine were typically constructed to a height of 36m, with the exception of an in-pit dump which was constructed to a height of 240m. The paper further indicates that mineralized waste (acid generating) was placed on a pad of barren (non-acid generating) waste rock with a wide encapsulation (up to 60m horizontally) of fresh barren rock. Any waste rock with a potential for acid generations was encapsulated in non-acid generating waste rock. Additionally, the top surface of the waste rock piles were designed to drain internally with a hummocked surface of loose rocky soil mulch a minimum of 1.5m thick. The mulch is underlain by a 0.5m thick compacted clay seal with a saturated hydraulic conductivity of about 10^{-8} m/s. The clay seal is underlain by 1m of compacted mineralized waste rock. Generally, the acid-generating waste dumps at the Kidston Mine are not constructed with typical store and release covers and although the outer slopes may have been constructed at 1.19H:1V to 1.33H:1V, the outer slopes consist of a thick (up to 60m) layer of inert material.

PT NEWMONT NUSA TENGGARA'S BATU HIJAU MINE (INDONESIA)

Table H-1 of the FS indicates that for closure, the waste rock pile slopes at the PT Newmont Mine will have overall side slopes of 2H:1V. However, a paper presented at the International Mine Water Symposium held in Brazil in 2001 titled *Stormwater Management and the Limited Discharge System of the Batu Hijau Mine* indicates that prior to revegetation, the overburden stockpile slopes will be constructed to 3H:1V, with the resulting overall slopes, including benches, having ratios at 3.25H:1V.

ASBESTOS MINE (CYPRUS)

Although Table H-1 in the FS indicates that Asbestos Mine will have waste rock pile slopes at 2H:1V at closure, it is important to recognize that the waste rock piles are non-acid generating and they will not be covered with a store and release cover.

Review of Stability Regulations, Factor of Safety (FOS)

In the FS Report, CMI has proposed that a long term static factor of safety value ranging from 1.3 to 1.5 is adequate for the roadside waste rock piles after reclamation, and that a factor of safety ranging from 1.0 to 1.1 is adequate for dynamic (earthquake) conditions. These parameters are based on a summary of Waste Rock Stability Guidelines and Regulations from a variety of sources presented in the FS Report.

The EPA does not disagree with the factor of safety *ranges* advocated by CMI. However, it is our opinion that the consequences of a failure should be considered when evaluating the stability of any rock pile and determining an acceptable minimum factor of safety. If a rock pile failure could result in damage to off-site properties, injury or loss of life, or unacceptable environmental consequences, such waste rock piles should be considered critical facilities and have a minimum static (non-earthquake) factor of safety of 1.5, and a minimum dynamic factor of safety of 1.1. If the calculated dynamic factor of safety falls below 1.1, a displacement analysis should be performed to evaluate the impact the earthquake would have on the rock pile. It is our opinion that a major failure of one of these waste rock piles could result in loss of life or injury, damage to off site properties, and could have unacceptable environmental consequences. As such, upper bound standard practice static and dynamic factors of safety shall be applied to the roadside waste rock piles. This is consistent with many regulatory agencies where the consequences of failure are considered with determining an acceptable factor of safety.

NEW MEXICO DEPARTMENT OF TRANSPORTATION

The New Mexico Department of Transportation requires a 1.3 static factor of safety for general highway bridges and a 1.5 static factor of safety in the vicinity of highway bridge support abutments, buildings, critical utilities, or other installations with a low tolerance for failure. We consider the roadside waste rock piles to have a low tolerance for failure and should have a post reclamation calculated factor of safety of 1.5.

BRITISH COLUMBIA WASTE ROCK PILE RESEARCH COMMITTEE

An Investigation and Design Manual Interim Guidelines prepared by the British Columbia Waste Rock Pile Research Committee indicates that where there is a high level of confidence in critical analysis parameters and critical failure mechanism(s), and rigorous stability analysis methods are used, and there are minimal consequences of failure, the suggested long term minimum static factor of safety is 1.3. Where there is a low level of confidence in the analysis parameters, poor understanding of potential failure mechanisms, simplified stability analysis methods are used, and a severe consequence of failure, the suggested long term minimum static factor of safety is 1.5. Regardless of the quality of the methodology used in the stability analysis, EPA considers the overriding factor to be the severe consequences of a failure of the roadside waste rock piles and as such, they should have a calculated post reclamation factor of safety of 1.5.

U.S. DEPARTMENT OF LABOR, MINE SAFETY, AND HEALTH ADMINISTRATION

Federal Regulation 30 CFR 77.215(h) requires a static safety factor of 1.5 for all refuse piles.

SURFACE MINING CONTROL AND RECLAMATION ACT (SMCRA)

The Federal regulations for impoundments (30 CFR 816.49), excess spoil disposal (30 CFR 816.71), durable rock fills (30 CFR 816.73), and coal mine waste disposal areas (30 CFR 816.81) all provide for static safety factor of 1.5. The State of New Mexico has primacy over SMCRA coal mining regulations (NMAC 19.20.8). One of the requirements for primacy is that the New Mexico Codes must be as stringent, or more stringent, than SMCRA regulations.

NEW MEXICO COAL MINING RULES (19.20.8 NMAC)

The FS indicates that the New Mexico Coal Mining Rules require a minimum static factor of safety of 1.3 for ponds, impoundments, banks, dams, and embankments. However, John Guranich, Engineer working with the State of New Mexico Coal mine Reclamation Program, indicated that the 1.3 static factor of safety only applies to waste rock piles located within a pit, and waste rock piles not located within a pit are required to have a static minimum factor of safety of 1.5. Mr. Guranich referred to 20.2034F of the coal regulations.

NEW MEXICO OFFICE OF THE STATE ENGINEER

The New Mexico Office of the State Engineer Dam Safety Bureau Rules and Regulations Governing Dam Design, Construction and Dam Safety requires that dams be designed for a minimum static factor of safety of 1.5 for long term stability per NMAC 19.25.12.11.C.(12). The Office of the State Engineer indicated the reason for this requirement is to protect property and the public from hazards of dam failure.

ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE, TECHNICAL GUIDANCE FOR RCRA/CERCLA FINAL COVERS

The Draft Technical Guidance for RCRA/CERCLA Final Covers for landfills present options with regard to factor of safety based on variables which include classifying the project as critical or non-critical and temporary or permanent. Where there is imminent danger to human life or major environmental impact if a slope fails, the minimum required static long-term factor of safety is 1.5. If there is uncertainty in strength measurements, a 2.0 or greater factor of safety is recommended. EPA considers the roadside rock piles as critical facilities since a major failure could result in injury, loss of life, damage to off site property and major environmental impacts. EPA 540-R-04-007 Check Table 2-1, make sure it says "Draft"

U.S. ARMY CORP OF ENGINEERS

The Army Corp of Engineers Engineering and Design Slope Stability Manual No. 1110-2-1902 indicates that the required minimum long-term static factor of safety of dams is 1.5.

**SOUTHERN CALIFORNIA EARTHQUAKE CENTER, RECOMMENDED PROCEDURES FOR
IMPLEMENTATION OF CALIFORNIA DIVISION OF MINES AND GEOLOGY SPECIAL
PUBLICATION 117-GUIDELINES FOR ANALYZING AND MITIGATING LANDSLIDE
HAZARDS IN CALIFORNIA**

The use of a minimum long term static factor of safety of 1.5 for slopes is recommended.

VARIOUS CITIES AND COUNTIES

Many cities and counties in the United States require a minimum static factor of safety of 1.5 and minimum seismic factor of safety of 1.1 for proposed hillside construction projects. Information was obtained from the department of public works and building and safety for various cities and counties, including the following:

- County of Los Angeles, California Department of Public Works, Manual for Preparation of Geotechnical Reports
- Geotechnical Report Guidelines, City of Tukwila, Washington
- Guidelines for Geotechnical Reports, City of San Diego, California
- Minimum Standards for Slope Stability Analyses, Geologic Hazards Ordinance, Title 16, Chapter 23 of Morgan County Municipal Code, Utah
- Guidelines for Geotechnical Reports, City of Santa Monica Building and Safety, California
- City of Malibu, California, Guidelines for Geotechnical Reports
- Orange County California Highway Design Manual
- City of Los Angeles Geotechnical Guidelines

In addition to a minimum static long term factor of safety of 1.5 being the most commonly used in the geotechnical industry, there are other reasons for using this parameter. An engineering design concept such as factor of safety is, in reality, only a factor of the experience and expertise of the engineer involved, where judgment decisions are made at every stage of the process. Slope stability analyses are fraught with uncertainties and judgment calls. It is not uncommon for different professionals to come up with wide variations in factors of safety for the same slope. The higher the calculated factor of safety, the greater the allowance for uncertainties and the lower the risk. Additionally, weathering and degradation of the waste rock piles could occur with time, resulting in lowered factors of safety.

Evaluation of Ground Water Remedies at Four New Mexico Sites

CMI is incorrect in their interpretation of ground water remedies at these New Mexico sites. At each of these sites and all other sites cleaned up under CERCLA, RCRA, or Water Quality Act authority in New Mexico, ground water standards are required to be met throughout the site, including beneath any wastes left in place. Under New Mexico regulations all ground water regulated by 20.6.2 NMAC (preliminary ARARs) is protectable at any place of withdrawal for present or reasonably foreseeable future use. The four examples cited by CMI are: Fruit Avenue Plume, ATSF- Albuquerque, Cleveland Mill and Cimarron Mining Company.

Fruit Avenue Plume

The site is a ground water contaminant plume in downtown Albuquerque. The contaminants are chlorinated solvents and the source of contamination is unknown. Ground water remediation is ongoing and standards are required to be met **everywhere** throughout the plume. There are no wastes left in place as part of remediation because, in part, the waste source was never found.

ATSF-Albuquerque

The site is a former wood treating facility with significant ground water contamination beneath the site. The contaminants are primarily creosote carcinogenic compounds. The ground water remediation system is under construction and the requirement under the ROD is to clean up **all** ground water contaminated by releases at the site. Construction of the remediation system is expected to be complete in 2011. Site wastes (soils contaminated with creosote) will be consolidated into a cell and left on site. Ground water standards are required to be met beneath the on-site waste cell.

Cleveland Mill

The site is a former mine and mill site located near Silver City. Cleanup of the site consisted of removal of contaminated tailings and sediments that were a source of acid rock drainage and metals contamination. Site wastes were removed and placed in an on-site repository cell. Ground water standards were never exceeded at the site except for some "perched" water discovered at the toe of the former tailings impoundment. This water disappeared after removal of the tailings and site ground water currently meets standards. Ground water monitoring of the repository cell continues to ensure that ground water beneath the cell does not become contaminated.

Cimarron Mining Company

The site is a former cyanide leach facility for gold recovery. Ground water beneath the site was contaminated with cyanide and nitrate. The ROD requires that ground water be cleaned up to standards **throughout the contaminated plume**. No wastes remain onsite that are a source of ground water contamination; however, the vadose zone remains an ongoing source of ground water contaminants.

CMI asserts that ground water cleanup was exempted at the Cimarron site without having to go through the Alternative Abatement Standards process. This is not true.

NMED and EPA have not exempted this site from ground water cleanup. Pump and treat technology was used at the site for close to 10 years in an attempt to clean up ground water contamination. Due in part to the low permeability of the aquifer and low yield from extraction wells, the system stopped being effective and was shut down. EPA contemplated a technical infeasibility waiver but the State did not agree with this approach and the waiver process was not started. The State has previously told EPA that Alternative Abatement Standards would be required if EPA moves forward with a technical infeasibility waiver.

The New Mexico WQCC standard continues to be exceeded for cyanide in several site monitoring wells. Efforts are ongoing to investigate mechanisms to achieve compliance with the standard. NMED is currently regrading portions of the site to minimize infiltration in areas where cyanide is concentrated in the vadose zone. If efforts to meet WQCC standards are unsuccessful a petition for alternative abatement standards would have to be made before the WQCC. The 2008 five year review for the site states "Discussions are ongoing between the Environmental Protection Agency (USEPA) and the New Mexico Environment Department regarding the appropriateness of setting an alternate cleanup standard based on concentrations of free cyanide in ground water."